PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

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International Patent Classification (IPC) or national classification and IPC

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Applicant

THOMSON LICENSING S.A. et al

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets, including this cover sheet.

3. This report is also accompanied by ANNEXES, comprising:

    a. ☒ *sent to the applicant and to the International Bureau)* a total of 6 sheets, as follows:

    ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).

    ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.

    b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

    ☒ Box No. I   Basis of the opinion

    ☐ Box No. II   Priority

    ☐ Box No. III   Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

    ☐ Box No. IV   Lack of unity of invention

    ☒ Box No. V   Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

    ☐ Box No. VI   Certain documents cited

    ☐ Box No. VII   Certain defects in the international application

    ☐ Box No. VIII   Certain observations on the international application

Date of submission of the demand 07.10.2005	Date of completion of this report 11.11.2005
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Willems, B Telephone No. +49 89 2399-8954

Box No. I   Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

    ☐   This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:

    ☐ international search (under Rules 12.3 and 23.1(b))
    ☐ publication of the international application (under Rule 12.4)
    ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

    Description, Pages

    1-14   as originally filed

    Claims, Numbers

    1-8   filed with telefax on 07.10.2005

    Drawings, Sheets

    1/3-3/3   as originally filed

    ☐   a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐   The amendments have resulted in the cancellation of:
    ☐ the description, pages
    ☐ the claims, Nos.   ·
    ☐ the drawings, sheets/figs
    ☐ the sequence listing *(specify)*:
    ☐ any table(s) related to sequence listing *(specify)*:

4. ☐   This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
    ☐ the description, pages
    ☐ the claims, Nos.
    ☐ the drawings, sheets/figs
    ☐ the sequence listing *(specify)*:
    ☐ any table(s) related to sequence listing *(specify)*:

    *   *If item 4 applies, some or all of these sheets may be marked "superseded."*

Box No. V   Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

   Novelty (N)   Yes: Claims   1-8
                                No: Claims

   Inventive step (IS)   Yes: Claims
                                No: Claims   1-8

   Industrial applicability (IA) Yes: Claims   1-8
                                No: Claims

2. Citations and explanations (Rule 70.7):

   see separate sheet

Re Item V
Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following documents:

    D1 = US-A-5 937 000

    D2 = US-A-5 687 191

    D3 = LOBOGUERRERO ET AL: 'Iterative Informed Audio Data Hiding Scheme Using Optimal Filter' ICCT 2003, vol. 2, 9 - 11 April 2003, pages 1408-1411, XP009029945 Beijing

2. The subject-matter of claim 1 lacks an inventive step with respect to the combination of the disclosures of documents D1 and D2. Therefore, claim 1 does not meet the requirements of Articles 33(1) and 33(3) PCT.

    Document D1 discloses (see figures 11 and 13, and column 16, line 26 to column 17, line 48) a method for transmitting watermark bits using a spread spectrum, the method including the steps of:

    modulating said watermark data bits on N encoder pseudo-noise sequence (286, 296, 306);

    spectral shaping the combined spread spectrum signals in an LPC synthesis filter to simulate the spectral shape of the primary data (column 17, lines 20 to 23);

    combining the watermark signal with the audio signal (column 17, lines 23 to 25); and

    transmitting the combined signal (see figure 13).

The PN generators can all operate at the same or different rates. If all PN generators operate at the same rate, than their PN sequences will preferably all be orthogonal with respect to each other to facilitate distinguishing the different input data streams at the decoder (column 16, lines 58 to 65).

It is clear from figure 11 of Document D1 that different signals modulated with orthogonal PN-sequences (280, 290, 300) are combined with one audio stream (260).

The subject-matter of claim 1 differs from the disclosure of Document D1 in that it specifies frequency and inverse frequency domain transformations and in that the claim specifies that the length of each pseudo-noise sequence is one N^{th} of the length of a frame of said audio signal.

However, Document D1 refers to spectral shaping. Therefore, the claimed frequency transformations are implicitly known form Document D1.

Further, it is well known to insert different parts(s) of the watermark(s) into different parts of the audio signal (see, for instance Document D2). The skilled person would inevitably try to provide said feature in the method known from Document D1. It is obvious to the skilled person that this requires adjusting the length of the PN sequences.

Thus, the subject-matter of claim 1 is rendered obvious by the disclosures of documents D1 and D2.

3. The subject-matter of claim 2 lacks an inventive step with respect to the combination of the disclosures of documents D1 and D3. Therefore, claim 2 does not meet the requirements of Articles 33(1) and 33(3) PCT.

Document D1 discloses (figure 12) a method for regaining watermark data bits embedded in a spread spectrum comprising the steps of receiving the combined audio and watermark signal and extracting the watermark signals using N orthogonal

pseudo-noise sequences.

The subject-matter of claim 2 differs from the disclosure of Document D1 in that the former specifies convolving corresponding sections of the audio signal with the time-inversed versions of the N orthogonal pseudo-noise sequences and determining from the signs of the peaks of the convolution results the value of the watermark data bits.

However, Document D3, page 1409 discloses an optimal detection method for spread spectrum watermarks. The method comprises the steps of convolving the received signal with the time-inversed version of the spreading sequence and determining from the signs of the peaks of the convolution results the value of the watermark data bits (see formula (4)).The examining division is of the opinion that the skilled person would inevitably try to substitute the despreading and demodulation in each of the branches of figure 12 with the optimal detection known from Document D3 using the respective pseudo-noise sequences.

Thus, the subject-matter of claim 2 is rendered obvious by the disclosures of documents D1 and D3.

4. The subject-matter of claim 3 lacks an inventive step with respect to the combination of the disclosures of Documents D1 and D3. Therefore, claim 3 does not meet the requirements of Articles 33(1) and 33(3) PCT.

Document D3 discloses an optimal detection method for spread spectrum watermarks comprising the steps of of convolving the received signal with the time-inversed version of the spreading sequence and determining from the signs of the peaks of the convolution results the value of the watermark data bits (see formula (4)).

The subject-matter of claim 3 differs from the disclosure of Document D3 in that the former further specifies combining time-shifted versions of the pseudo-noise orthogonal sequences to construct a modified decoder sequence.

However, the construction of the modified sequence is normal design procedure to compensate for echo delays.

It is obvious to the skilled person that compensation for echoes is also necessary when using multiple orthogonal sequences. Further, reference is made to the objections raised against claim 2.

Thus, the subject-matter of claim 3 is rendered obvious by the disclosures of Documents D1 and D3.

5.   The subject-matter of claim 4 lacks an inventive step with respect to the combination of the disclosures of documents D1 and D3. Therefore, claim 4 does not meet the requirements of Articles 33(1) and 33(3) PCT.

Claim 4 further specifies an obvious detail of the processing of the echo delays.

5.   The subject-matter of claims 5 to 8 lacks an inventive step with respect to cited prior art. Therefore, claims 5 to 8 do not meet the requirements of Articles 33(1) and 33(3) PCT.

Claims 5 to 8 specify apparatuses comprising features corresponding to the method steps of claims 1 to 4, respectively. Therefore, claims 5 to 8 are objected to for the reasons set out above.

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Claims

1. Method for transmitting watermark data bits (IWATD) using
   a spread spectrum, said method including the steps:
5 - modulating (BVMOD) said watermark data bits on an encoder
   pseudo-noise sequence (ENCPNSEQ);
   - transforming (WATSE) said modulated encoder pseudo-noise
   sequence (WATS) into the frequency domain and shaping it
   in amplitude according to the masking level curve of an
10 audio signal together with which the watermark data bit
   information is to be transmitted or transferred, and
   transforming (WATSE) said shaped encoder pseudo-noise
   frequency domain sequence back into the time domain;
   - combining (WATSE) said inverse transformed encoder
15 pseudo-noise frequency domain sequence with a current
   frame of data of said audio signal, wherein the length of
   said encoder pseudo-noise sequence (ENCPNSEQ) is one Nth
   of the length of said audio signal frame, N being an in-
   teger number greater one, and wherein N orthogonal en-
20 coder pseudo-noise sequences (ENCPNSEQ) are used per au-
   dio signal frame for carrying out said combining for cor-
   responding sections of said current frame;
   - transmitting or transferring (TRM) said combined current
   audio signal frame carrying said watermark data bits.
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2. Method for regaining watermark data bits (IWATD) embedded
   in a spread spectrum, whereby the corresponding original
   watermark data bits were modulated (BVMOD) at encoder
   side on an encoder pseudo-noise sequence (ENCPNSEQ) and
30 said modulated encoder pseudo-noise sequence (WATS) was
   transformed (WATSE) into the frequency domain and shaped
   in amplitude according to the masking level curve (PSYMC)
   of an audio signal together with which the watermark data
   bit information was transmitted or transferred (TRM), and
35 said shaped encoder pseudo-noise frequency domain se-
   quence was transformed (WATSE) back into the time domain

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and was combined with a current frame of data of said au-
dio signal, wherein the length of said encoder pseudo-
noise sequence (ENCPNSEQ) was one Nth of the length of
said audio signal frame, N being an integer number
5   greater one, and wherein N orthogonal encoder pseudo-
noise sequences (ENCPNSEQ) were used per audio signal
frame for carrying out said combining for corresponding
sections of said current frame,
said method including the steps:
10   - receiving (REC, SYNC) and synchronising said transmitted
or transferred audio signal;
- convolving (DRECMF) each one of a corresponding section
of said current frame of data of said audio signal with
the corresponding one of time-inversed versions
15   (DECPNSEQ) of the N orthogonal encoder pseudo-noise se-
quences;
- determining (DRECMF), for each one of said sections, from
the sign of the peak or peaks of the corresponding convo-
lution result the value of a bit of said watermark data
20   (OWATD).

3. Method for regaining watermark data bits (IWATD) embedded
in a spread spectrum, whereby the corresponding original
watermark data bits were modulated (BVMOD) at encoder
25   side on an encoder pseudo-noise sequence (ENCPNSEQ) and
said modulated encoder pseudo-noise sequence (WATS) was
transformed (WATSE) into the frequency domain and shaped
in amplitude according to the masking level curve (PSYMC)
of an audio signal together with which the watermark data
30   bit information was transmitted or transferred (TRM), and
said shaped encoder pseudo-noise frequency domain se-
quence was transformed (WATSE) back into the time domain
and was combined with a current frame of data of said au-
dio signal, wherein the length of said encoder pseudo-
35   noise sequence (ENCPNSEQ) was one Nth of the length of
said audio signal frame, N being an integer number

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greater one, and wherein N orthogonal encoder pseudo-
noise sequences (ENCPNSEQ) were used per audio signal
frame for carrying out said combining for corresponding
sections of said current frame,

5   said method including the steps:

- receiving (REC, SYNC) and synchronising said transmitted
  or transferred audio signal;
- determining (EDET) in the received audio signal one or
  more echoes and the related echo delays;

10   - assembling together the N time-inversed versions of said
  orthogonal encoder pseudo-noise sequences (ENCPNSEQ) for
  a current frame and constructing a modified decoder
  pseudo-noise sequence (MDECPNSEQ) based on the time-
  inversed version of said encoder pseudo-noise sequence

15   (ENCPNSEQ) whereby, according to the echo delay or delays
  determined, correspondingly time-shifted versions of said
  time-inversed encoder pseudo-noise sequence are combined
  in order to construct said modified decoder pseudo-noise
  sequence;

20   - convolving (DRECMF) each one of a corresponding section
  of said current audio signal frame with the corresponding
  section of said modified decoder pseudo-noise sequence
  (MDECPNSEQ);
- determining (DRECMF), for each one of said sections, from

25   the sign of the peak or peaks of the corresponding convo-
  lution result the value of a bit of said watermark data
  (OWATD).

4. Method according to claim 3 wherein, when determining

30   (EDET) in the received audio signal one or more echoes
  and the related echo delays, the results for several au-
  dio frames are evaluated before a final result on the
  echo delay is formed.

35 5. Apparatus for transmitting watermark data bits (IWATD)
  using a spread spectrum, said apparatus including:

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- means (BVMOD) for modulating said watermark data bits on
  an encoder pseudo-noise sequence (ENCPNSEQ);
- means (WATSE) for transforming said modulated encoder
  pseudo-noise sequence (WATS) into the frequency domain
5   and for shaping it in amplitude according to the masking
  level curve of an audio signal together with which the
  watermark data bit information is to be transmitted or
  transferred, and for transforming said shaped encoder
  pseudo-noise frequency domain sequence back into the time
10   domain;
- means (WATSE) for combining said inverse transformed en-
  coder pseudo-noise frequency domain sequence with a cur-
  rent frame of data of said audio signal, wherein the
  length of said encoder pseudo-noise sequence (ENCPNSEQ)
15   is one Nth of the length of said audio signal frame, N
  being an integer number greater one, and wherein N or-
  thogonal encoder pseudo-noise sequences (ENCPNSEQ) are
  used per audio signal frame for carrying out said combin-
  ing for corresponding sections of said current frame;
20 - means (TRM) for transmitting or transferring said com-
  bined audio signal frame or frames carrying said water-
  mark data bits.

6. Apparatus for regaining watermark data bits (IWATD) em-
25   bedded in a spread spectrum, whereby the corresponding
  original watermark data bits were modulated (BVMOD) at
  encoder side on an encoder pseudo-noise sequence
  (ENCPNSEQ) and said modulated encoder pseudo-noise se-
  quence (WATS) was transformed (WATSE) into the frequency
30   domain and shaped in amplitude according to the masking
  level curve (PSYMC) of an audio signal together with
  which the watermark data bit information was transmitted
  or transferred (TRM), and said shaped encoder pseudo-
  noise frequency domain sequence was transformed (WATSE)
35   back into the time domain and was combined with a current
  frame of data of said audio signal, wherein the length of

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said encoder pseudo-noise sequence (ENCPNSEQ) was one Nth
of the length of said audio signal frame, N being an in-
teger number greater one, and wherein N orthogonal en-
coder pseudo-noise sequences (ENCPNSEQ) were used per au-
5 dio signal frame for carrying out said combining for cor-
responding sections of said current frame,
said apparatus including:
- means (REC, SYNC) for receiving and synchronising said
transmitted or transferred audio signal;
10 - means (DRECMF) for convolving each one of a corresponding
section of said current frame of data of said audio sig-
nal with the corresponding one of time-inversed versions
(DECPNSEQ) of the N orthogonal encoder pseudo-noise se-
quences, and for determining, for each one of said sec-
15 tions, from the sign of the peak or peaks of the corre-
sponding convolution result the value of a bit of said
watermark data (OWATD).

7. Apparatus for regaining watermark data bits (IWATD) em-
20 bedded in a spread spectrum, whereby the corresponding
original watermark data bits were modulated (BVMOD) at
encoder side on an encoder pseudo-noise sequence
(ENCPNSEQ) and said modulated encoder pseudo-noise se-
quence (WATS) was transformed (WATSE) into the frequency
25 domain and shaped in amplitude according to the masking
level curve (PSYMC) of an audio signal together with
which the watermark data bit information was transmitted
or transferred (TRM), and said shaped encoder pseudo-
noise frequency domain sequence was transformed (WATSE)
30 back into the time domain and was combined with a current
frame of data of said audio signal, wherein the length of
said encoder pseudo-noise sequence (ENCPNSEQ) was one Nth
of the length of said audio signal frame, N being an in-
teger number greater one, and wherein N orthogonal en-
35 coder pseudo-noise sequences (ENCPNSEQ) were used per au-
dio signal frame for carrying out said combining for cor-

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responding sections of said current frame
said apparatus including:

- means (REC, SYNC) for receiving and synchronising said
  transmitted or transferred audio signal;

5 - means (EDET) for determining in the received audio signal
  one or more echoes and the related echo delays, and for
  assembling together the N time-inversed versions of said
  orthogonal encoder pseudo-noise sequences (ENCPNSEQ) for
  a current frame and for constructing a modified decoder

10 pseudo-noise sequence (MDECPNSEQ) based on the time-
  inversed version of said encoder pseudo-noise sequence
  (ENCPNSEQ) whereby, according to the echo delay or delays
  determined, correspondingly time-shifted versions of said
  time-inversed encoder pseudo-noise sequence are combined

15 in order to construct said modified decoder pseudo-noise
  sequence;

- means (DRECMF) for convolving said current frame of data
  of said audio signal with said modified decoder pseudo-
  noise sequence (MDECPNSEQ), and for determining, for each

20 one of said sections, from the sign of the peak or peaks
  of the corresponding convolution result the value of a
  bit of said watermark data (OWATD).

8. Apparatus according to claim 7 wherein, in said determin-
25 ing means (EDET), in the received audio signal one or
  more echoes and the related echo delays, the results for
  several audio frames are evaluated before a final result
  on the echo delay is formed.